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(54) **LOAD INSENSITIVE BALANCED POWER AMPLIFIER AND RELATED OPERATING METHOD**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,656,434 A 4/1987 Selin
6,211,734 B1 * 4/2001 Ahn ..... 330/124 R
6,297,696 B1 10/2001 Abdollahian et al.
6,614,299 B2 * 9/2003 Hirvilampi et al. ..... 330/124 R
7,138,861 B2 11/2006 Sundstrom et al.
7,411,450 B2 * 8/2008 Albrecht ..... 330/124 R

* cited by examiner

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(57) **ABSTRACT**

A balanced power amplifier that is insensitive to load line variations is provided. The balanced power amplifier is suitable for use in wireless transmitter applications, such as cellular telephones, mobile computing devices, and portable communication devices. An embodiment of such a balanced power amplifier includes an input coupler, first and second amplifier devices, and a level adjustment component. The input coupler generates a first signal component and a second signal component from an input signal, where the first signal component and the second signal component are out of phase relative to one another. The first amplifier device generates a first output signal that is influenced by the first signal component, and the second amplifier device generates a second output signal that is influenced by the second signal component. The level adjustment component is coupled between the input coupler device and the input of the first amplifier device. The level adjustment component performs signal level tuning on its input signal. The signal level tuning is adaptively performed in response to the impedance characteristics of the load being driven by the balanced power amplifier.

15 Claims, 6 Drawing Sheets